

Examining the Interaction Effect of 7E Model of Constructivist Pedagogical Approach and Science Self-Efficacy on Attitude towards Science

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Abstract: *The main purpose of the study was to investigate the interaction effect of 7E learning instructional model and science self-efficacy on ninth grade students' attitude towards science. Data was collected using science self-efficacy scale and attitude towards science scale. The sample comprised of 120 secondary school students studying in government schools of Shaheed Bhagat Singh Nagar district, Punjab, India. The findings revealed that students in different levels of science self-efficacy of experimental group were positively affected by 7E learning model based teaching strategy but, it is the high science self-efficacy group students who got benefitted to the greatest extent with 7E learning model based instruction.*

Keywords: 7E learning instructional model, Attitude towards science, Science self-efficacy

1. Introduction

In today's world we should not underestimate the scope of science as its impact can be seen everywhere. The practical effects of science can be seen in motion everywhere, from path breaking discoveries in atomic science to discovery of new vaccines in life science, to technological advancements in the field of transportation, weather prediction and communication, it has left no aspect of human's untouched and thus science can be considered as a backbone for human survival. It has occupied a prime position in the nation's growth and development (Odunusi, 2001). The science education in today's education scenario should aim at understanding the nature of science (NOS) and the nature of science can be learned by doing science or learning through science. Understanding the nature of science is also a necessary ingredient for full realization of a human being. In the post independent India, our constitution adopted the goals of establishing the society based on the scientific temper, humanism and spirit of inquiry. It enshrines in Article 51A(h) of the constitution that it is the fundamental duty of every citizen of the country to inculcate, propagate and further disseminate the scientific temper in society (NCERT, 2006).

According to the Ministry of Human Resource Development Report (as cited in NEP, 2019) scientific temper should be inculcated in school science education and evidence-based thinking should be encouraged throughout the curriculum which will lead naturally to rational ethical and compassionate students who can make good, logical and sound decisions throughout their lives. The NCERT (2006) position paper on science has recognized that the major intention or goal of science teaching is to prepare the students who are willing to enter in the competitive global world. This will evoke in them the most celebrated learning method of Socrates that is discovery through inquiry and then the learning process will take place in its true essence. It will also help in nourishing and garnishing their skills and knowledge and subsequently using them in a broad spectrum. NCERT (2008) explicitly highlighted the

importance of constructivism as a teaching approach for understanding the nature of science. By adopting such pedagogical approach students will be able to understand or develop various processes involved in doing science since students are given spaces for their own ideas and imagination.

7E learning instructional model is a useful recommended strategy in science curriculum and teachers should be encouraged to incorporate this strategy into their teaching. The primary aim of the 7E learning cycle is to highlight the increasing importance of provoking previous understanding of transferring the concept to new contexts (Balta & Sarac, 2016). 7E learning model can stimulate students to recall previous material, can improve their learning outcomes because this model prioritizes student experience, motivate students to be more active and increase curiosity, train students to learn concepts through experimental activities (Marfilinda, Zaturrahmi & Indrawati, 2019).

Self-efficacy belief is an important aspect of human behaviour and motivation as well as influences the actions that can affect individual's life. The basic principle or a theory behind self-efficacy is that learners are more likely to engage in those activities for which they have high self-efficacy and less likely to engage in those for which they have low self-efficacy (Vander Bijl & Shortridge-Baggett, 2002). All learners can identify their goals they would like to accomplish, things they want to achieve but putting such plans into actions is not so easy. In terms of thinking, a strong sense of competence will facilitate performance and cognitive processes in a variety of settings which includes academic achievement and decision making ability. In terms of act, self-related cognition is considered as a major ingredient of the motivation process in case of students with higher level of self-efficacy in comparison to low self-efficacy students (Litt, 1988).

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2. Research Trends

From the above review on self-efficacy and science self-efficacy, it can be culminated that there exists significant relationship of self-efficacy with academic achievement in various subjects (Paixao and Panahandeh, 2017; Fernando et al., 2017 ; Roebianto, 2020 ; Burns et al., 2021). Lee et al., (2019) indicated that the students' conceptions of science laboratory learning made a significant contribution to their perceptions of the science laboratory environment which consequently fostered their science learning self-efficacy. Hoffman & Spatariu (2008) clearly stated that self-efficacy enhanced the problem solving performance among the students. Zimmerman (2000) advocated that self-efficacy has emerged as highly effective predictor of student's motivation and learning. Fernando, Laura and Amparo (2017) revealed that students' expectancy-value beliefs, process expectancy, achievement expectancy and cost expectancy played a mediator role between academic self-efficacy and the achievement/satisfaction relationship. The findings of Huang (2013); Uitto (2014) and Lima, Winsler & Kitsantas (2014) revealed that males had higher self-efficacy than females.

Kurnia & Nela (2016) stated that 7E model is effective in improving the self-efficacy and critical thinking skills among the students. Susskind (2005) found out improvement in student's self-efficacy attitude with power point multimedia. Baker & White (2003) revealed that geographic information system approach had a positive effect on student's self-efficacy and attitude towards science. Gardner (2014) investigated no significant predictive relationship between the predictor variables of self-efficacy, ethnicity or gender and academic performance. Rani (2011) found out no significant difference between the experimental and control group in terms of achievement in science and anxiety with high and low self-efficacy of experimental and control group. Kocakaya & Gonen (2010) found out that CAI (Computer Aided Instruction) 7E approach was more effective than 7E model in enhancing the self-efficacy of students.

3. Research Problem

To examine the interaction effect of instructional strategies and science self-efficacy on mean gain attitude towards science scores.

4. Hypothesis

There will be no significant interaction effect of instructional strategies and science self-efficacy on mean gain attitude towards science scores.

5. Rationale of the Study

Surveys conducted in science subject at middle, secondary stage levels in recent years presented grim pictures of students' interest in science subject and their achievement levels. Report issued by Program for International Student Assessment (PISA) in 2009 (as mentioned in OECD,2011) reflected that India ranked second last among the 73 countries that participated, leaving behind only Kyrgyzstan. Another report that raised concern regarding science education in India was from the survey conducted by the National Council of Applied Economic Research (NCAER, 2013) which revealed that the number of students opting for science after the secondary school stage has dropped from 32 per cent to 19.7 per cent in recent years. This indicates that the young students particularly the brighter ones are drifting away from science. As reported by Homi Bhabha Centre for Science Education, very few students selected for olympiads in Chemistry, Physics or Biology. According to MHRD report (as cited in NEP,2019), there has been an absolute decrease of 33 per cent in the number of students opting for science while the numbers in banking, technology, commerce and management have increased considerably. This could be a result of shift in students' interest to pursue courses which have better career options than science. So, we really need to diagnose the ailments and find the necessary cure by incorporating novel teaching strategies in the field of science.

6. Research Methodology

The study utilized 2X3 factorial design was used to analyse the gains on attitude towards science. 7E learning instructional model and science self-efficacy were independent variables and attitude towards science was dependent variable. The systematic layout of second factorial design is presented in figure 1.1.

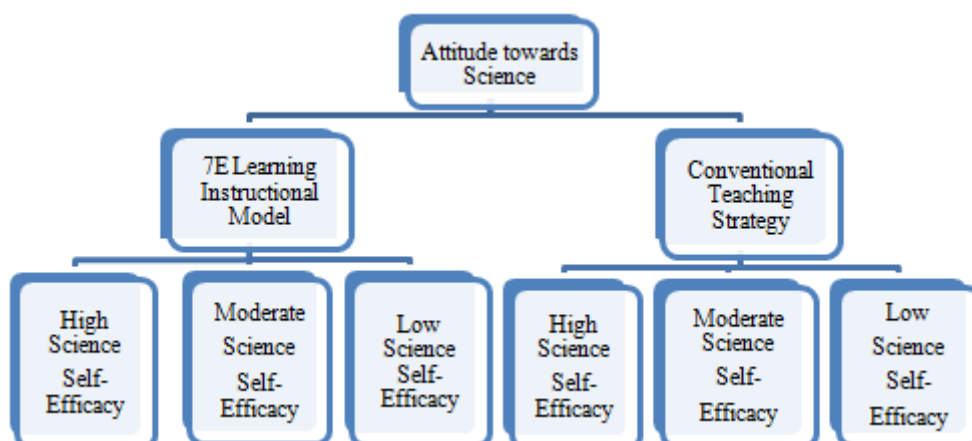


Figure 1.1: Schematic Layout of 2X3 Factorial Design for Attitude towards Science

7. Results and Discussions

The scores of pre and post-test of attitude towards science were considered as near normal after subjected to descriptive analysis. Hence it was concluded that the sample was normally distributed. The equivalence between experimental and control group was established by matching the two groups on scores of attitude towards

science by employing t-test. Results of the Levene's test demonstrated that the assumption of homogeneity of variance has been satisfied as the p-value in all the sample groups was more than 0.05. Hence it is proved that the variances of the groups are equal. The 2X3 Analysis of Variance factorial design was employed and F-values were computed for mean gain attitude towards science in order to study the interaction effect.

Table 1.1 A Summary of 2X3 Analysis of Variance on Mean Gain Attitude towards Science Scores

Tests of Between-Subjects Effects					
Dependent Variable: Attitude towards Science (Mean Gain)					
Source	Type III Sum of Squares	Df	Mean Square	F-value	p-value
Instructional strategy(A)	1540.833	1	1540.833	32.055	.0001**
Science self-efficacy(B)	525.350	2	262.675	5.465	.005**
Instructional strategy X Science self-efficacy (AXB)	302.517	2	151.258	3.147	.047*
Error	5479.800	114	48.068		
Total	7848.500	119			

R Squared = .229 (Adjusted R Squared = .196)

The interaction effect of instructional strategies and science self-efficacy on mean gain attitude towards science scores was examined by computing the p-value as mentioned in table 1.1. The p-value came out to be .047 which was significant at 0.05 level of significance, leading to *rejection of null hypothesis (H_{01}) stating that, "There will be no significant interaction effect of instructional strategies and science self-efficacy on mean gain attitude towards science scores at 0.05 level of significance."* The results indicate that the mean gain attitude towards science scores differed significantly due to the interaction of instructional strategies and science self-efficacy.

8. Conclusion

The results explain that different groups attained different mean gain attitude towards science score on the variable of attitude towards science for two types of instructional strategies and three levels of science self-efficacy which suggests that students possessing different levels of science self-efficacy (Low, moderate and high) achieved differently in attitude towards science when taught with different instructional strategies (7E learning model and conventional teaching method). The graphical representation of same is illustrated in figure 1.2.

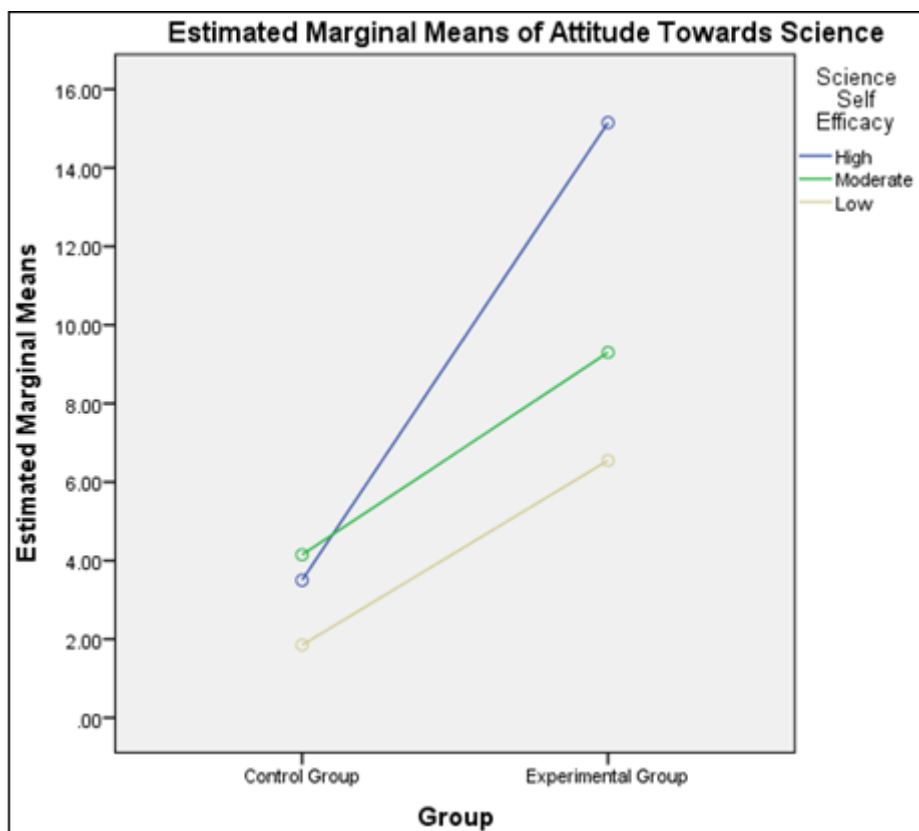


Figure 1.2 Graph showing interaction effect of instructional strategies and science self-efficacy on mean gain attitude towards science scores

9. Educational Implications

- The present study has established that 7E learning based instruction is a more effective teaching strategy than conventional teaching in terms of improving the attitude towards science. Therefore, 7E learning instructional model can be used by teachers in their courses to attain an effective student-centered learning environment in the classrooms.
 - Because of the positive effect of 7E learning model based instruction on students' attitude towards science, this technology can make learning science easy and motivates more and more students to opt science for higher studies which would further offer better future prospects for them.
 - The 7E learning instructional approach was found helpful in developing the questioning ability, creativity in framing questions, inductive reasoning, problem solving ability and creative thinking skills among the students.
 - This study revealed that students become more enthusiastic and encouraged to use this in other subjects also. Therefore, this study thus has implications for all concerning authorities i.e. for school administrators, curriculum developers, teachers, parents and students.
 - The 7E learning instructional strategy brought changes among learners as various strategies like collaborative learning, think pair share, group discussion, experiment, etc were used. Such strategies created opportunities for the students to work together and developed a sense of mutual respect and care for each other.
 - There must also be in-service and pre-service teacher training programmes to make teacher and perspective teachers aware about the 7E learning instructional model that broadens their horizon of understanding the subject.
 - The teachers must include such activities during the teaching learning process that involves various senses and movement as it caters to multiple intelligence.
- The comparative studies may be conducted in which 7E Learning instructional approach can be compared with other instructional approaches.
 - The study can be replicated on the students of same class to validate and generalize the results.
 - A comparative study can be carried out on students of government/private and rural/urban schools including higher education and teacher training programmes.
 - The studies can be done to study the perception of science teachers and teacher trainees about teaching methods in relation to awareness about 7E learning instructional model.
 - The study included students selected randomly having different cognitive levels. The same can be implemented on the sample of bright learners as well as slow bloomers to further explore its effectiveness on acquisition of concepts among learners at upper and lower extreme end.

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10. Suggestions for Further Research

Based on the findings and respective conclusions drawn from the present study, few suggestions have been proposed for related future studies discussed as below:

- The present study was confined to Shaheed Bhagat Singh (S.B.S) Nagar district of Punjab state, however the study may be extended to other districts of Punjab and other states of India.
- The present study was demarcated to the students of class IXth only, however to further corroborate this finding, the same experiment may be carried out on the students at elementary, higher secondary, college and university level. Thus offering a broader scope in variability in academic performance.
- In this study, only one classifying variable (science self-efficacy) was selected. There can be more classificatory variables such as socio economic status, cognitive styles, motivational achievement etc.
- Gender can also be considered as one of the major variable during teaching through 7E learning instructional model. The studies may be conducted to see the effect of this approach on stream or on locale also.

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